

WHAT IS CLAIMED IS:

1. A system for filling a substrate having at least one chamber with a liquid sample, comprising:

a substrate defining a network of passageways including at least one chamber for the liquid sample;

an adapter, said adapter including a fill reservoir for the liquid sample, a vacuum port for attachment to a vacuum source, and at least two channels, one channel allowing a vacuum to be imparted to the network, and the other channel for allowing the liquid sample to be introduced into the network; and

a mechanism that sequentially closes and opens at least one of said channels so that a vacuum can first be introduced to the substrate and thereafter the liquid sample can be introduced to the substrate for permitting said vacuum to urge the liquid sample to flow from the fill reservoir into the substrate, said mechanism including:

a frame that holds at least one adapter and substrate, and

a valving mechanism that sequentially sealingly engages and disengages said channels of the adapter.

2. The system of claim 1, wherein the at least one channel of the adapter defines a first flow path between the vacuum port and the network of passageways, and a second flow path between the fill reservoir and the network of passageways.

3. The system of claim 2, wherein at a first setting the valving mechanism closes the second flow path while opening the first flow path to communication between the vacuum port and the network of passageways, in order to allow a vacuum to be applied to the network of passageways.

5. 4. The system of claim 3, wherein at a second setting the valving mechanism closes the first flow path while opening the second flow path to communication between the fill reservoir and the network of passageways, in order to allow the liquid sample to flow from the fill reservoir into at least one chamber of the substrate.

10. 5. The system of claim 4, wherein the at least one channel of the adapter further defines a third flow path between the fill reservoir and an end reservoir, the valving mechanism closing the third flow path when the valving mechanism is at said second setting in order to reduce the amount of air in the substrate upon filling.

15. 6. The system of claim 2, wherein the valving mechanism further includes movable actuator wheels for sealingly engaging and disengaging said channels for closing and opening the flow paths.

7. The system of claim 6, wherein said moveable actuator wheels are located in an actuator housing so that movement of an actuator results in the displacement of the wheels from a first position to a second position.

8. The system of claim 1, wherein said adapter comprises at least one plate that is removably mounted on the substrate during filling, and is removeable from the substrate upon filling the substrate with the sample liquid.

9. The system of claim 8, further comprising a sealing means for sealing the network of passageways from the atmosphere after filling the substrate with the sample liquid and removing the at least one plate from the substrate.

10. The system of claim 9, wherein said substrate includes a plate with a plurality of said chambers for the liquid sample.

11. The system of claim 1, wherein the sample detection chamber of the substrate includes an analyte-specific reagent effective to react with a specific analyte that may be present in the liquid sample.

12. A substrate filling member configured for connection to a substrate having at least one chamber for a liquid sample, the filling member comprising:

a base;
a reservoir on said base, said reservoir configured to receive a liquid sample;
a vacuum port on said base, said vacuum port configured for attachment to a vacuum source; and

5 a plurality of fluid channels in the base, the plurality for fluid channels including a first fluid channel for permitting a vacuum to be imparted to the substrate and at least one fluid channel of the filling member at a first setting, the plurality of fluid channels permitting the liquid sample from the fill reservoir to flow into the at least one chamber of the substrate at a second setting.

10 13. The substrate filling member of claim 12, wherein said base comprises first and second plates joined together, one of said plates including the fill reservoir, and the other plate forming the at least one fluid channel.

15 14. The substrate filling member of claim 13, further including a fill port for connecting to the substrate, the fill port serving as the flow path for the liquid sample from the filling member to the substrate.

15 15. The substrate filling member of claim 14, wherein one of said plates of the base includes a vacuum port, the plurality of fluid channels of the filling member

including a first flow channel between the vacuum port and the fill port, and a second flow channel between the fill reservoir and the fill port.

5 16. The substrate filling member of claim 15, further comprising an air reservoir, the plurality of fluid channels of the filling member further including a third flow channel between the fill reservoir and the air reservoir.

17. The substrate filling member of claim 15, further including at least one alignment member for mating with a corresponding alignment member on a top surface of the substrate.

10 18. The substrate filling member of claim 12, wherein the plurality of fluid channels are defined by material having elastic properties so that each of the channels can be selectively opened and closed by imparting a pressing force on the channel.

19. The substrate filling member of claim 12, further including alignment holes for alignment with pins on a surface on which the substrate filling member is placed during filling of the substrate.

20. A filling station for controlling the filling of substrate having at least one chamber with a liquid sample, the filling station comprising:

a base portion receiving the substrate and an adapter including a filling reservoir, vacuum port, and plurality of flow paths; and

an actuator selectively directing the liquid sample into the at least one sample chamber of the substrate when the actuator is in a predetermined position, said actuator including a plurality of valving structures for selectively opening and closing flow paths on the adapter according to a predetermined procedure.

21. The filling station of claim 20, further including an actuator housing in which the actuator is mounted, the actuator housing having an open position so that the adapter and substrate may be loaded into the base portion of the filling station, and a closed position where the actuator housing contacts a top surface of the adapter.

22. The filling station of claim 21, wherein the valving structures are movable within the actuator housing between a plurality of positions for selectively opening and closing said flow paths.

23. The filling station of claim 22, wherein the valving structures include a plurality of surfaces for closing a first, second, or third flow path of the adapter by pressing against predetermined portions of the adapter.

24. The filling station of claim 22, further comprising an upper plate, said upper plate and said actuator housing being pivotally attached to said base portion.

25. The filling station of claim 24, said upper plate including a vacuum attachment structure for attachment to said vacuum port of the adapter.

26. The filling station of claim 22, wherein the valving structures comprise a wheel assembly, said wheel assembly including three wheels that are slidable along the upper surface of the adapter.

27. The filling station of claim 26, wherein the actuator includes an actuator shaft that is connected to the wheel assembly and axially movable relative to the actuator housing, said actuator shaft being configured for movement between the plurality of positions for selectively opening and closing said flow paths.

28. Method of filling at least one chamber of a substrate with a liquid sample, comprising the steps of:

providing a substrate having at least one chamber for containing a liquid sample and at least one path for accessing the chamber;

providing an adapter for connection to the substrate, said adapter having a fill reservoir for the liquid sample, a vacuum port, and a plurality of channels;

5 closing a control apparatus so that the substrate and adapter are fixed therein;
inserting a liquid sample into the fill reservoir of the adapter;
introducing a vacuum to the chamber and path of the substrate;
actuating the control apparatus in order to expose the liquid sample in the fill
reservoir to the vacuum so that the liquid sample is urged towards the chamber of the
substrate.

10 29. The method of claim 28, wherein prior to the step of inserting a liquid
sample into the reservoir, the method includes the further step of closing a channel
between the fill reservoir and the chamber of the substrate and permitting
communication between the vacuum port of the adapter and the chamber of the
substrate.

15 30. The method of claim 29, wherein the step of actuating the control
apparatus includes the step of closing a channel between the vacuum port and the
chamber of the substrate, thereby permitting the liquid sample in the fill reservoir to be
exposed to the vacuum in the chamber and consequently flow into the chamber of the
substrate.

31. The method of claim 30, wherein the step of actuating the control apparatus further comprises the step of closing a channel between the fill reservoir and an air reservoir of the adapter.

32. The method of claim 28, wherein the step of providing a substrate having at least one chamber includes the step of providing an analyte-specific reagent in the chamber effective to react with a specific analyte that may be present in the liquid sample.

33. Method of filling chambers of a sample plate with a liquid sample, comprising the steps of:

placing the sample plate in a holder;
applying a vacuum to the chambers of the sample plate;
inserting a liquid sample into a fill reservoir;
moving an actuator of the holder to expose the liquid sample to the vacuum in the chambers, thereby causing the liquid sample to flow into the chambers of the sample plate.

34. The method of claim 33, wherein prior to the step of applying a vacuum, the method comprises the step of closing a passageway between the fill reservoir and the chambers.

35. The method of claim 34, wherein the step of moving an actuator of the holder opens the passageway between the fill reservoir and the chambers to allow communication between the fill reservoir and the chambers, while simultaneously closing a passageway between the source of the vacuum and the chambers of the sample plate.

36. An actuator for opening and closing flow paths of an adapter for a substrate with at least one sample chamber, the adapter being removably mounted on the substrate to provide a fill reservoir and vacuum port for the substrate, the actuator comprising:

a plurality of engaging surfaces movable in a longitudinal direction between an initial first position and a second position; and

an engaging member for applying a force to longitudinally move the plurality of engaging surfaces from the first position to the second position,

wherein the plurality of engaging surfaces selectively open and close fluid channels on the adapter, in the first position said engaging surfaces close a fluid channel between the fill reservoir and the sample chamber, in the second position said engaging surfaces close the fluid channel between the vacuum port and the sample chamber.

37. The actuator of claim 36, wherein the plurality of engaging surfaces are provided with spring elements to allow relative movement between the engaging surfaces and the housing in which the engaging surfaces are located.

5 38. A system for filling a substrate with a liquid sample, the substrate including a network of passageways including at least one chamber with a liquid sample, the system comprising:

10 means for connecting to the substrate, the means for connecting including means for receiving a liquid sample, means for applying a vacuum, and a plurality of channels selectively permitting communication between said means for receiving the liquid sample, said means for applying a vacuum, and the network;

control means for sequentially closing and opening at least one of said channels;

15 means for closing the control means so that the substrate and means for connecting are fixed therein;

means for inserting a liquid sample into the means for receiving;

means for introducing a vacuum to the chamber and network of the substrate;

and

means for actuating the control means in order to expose the liquid sample in the receiving means to the vacuum so that the liquid sample is urged towards the chamber of the substrate.

39. An apparatus for positioning a substrate with a plurality of sample detection chambers in a detection unit, comprising:

a frame assembly, said frame assembly configured so that a substrate may be positioned in the frame assembly; and

5 a lens assembly, said lens assembly including a plurality of plates, one of said plates comprising a lens plate in which at least one lens is located for focusing a light which passes through the lens.

40. The apparatus of claim 39, wherein said lens assembly includes a top plate with at least one hole corresponding to each lens of the lens plate.

10 41. The apparatus of claim 40, wherein said lens assembly further includes a middle plate, said middle plate providing support for each lens of the lens plate, said middle plate being pressed against a bottom surface of the top plate and the lens plate.

15 42. The apparatus of claim 41, wherein said middle plate includes a plurality of flexible biasing members for providing support for each lens of the lens plate by biasing each lens toward the lens plate.

43. The apparatus of claim 42, wherein each flexible biasing member comprises radially extending arms positioned around a hole in the middle plate aligned with each lens of the lens plate.

5 44. The apparatus of claim 39, wherein said lens plate includes a sealing element on the bottom surface thereof for engaging said substrate.

45. The apparatus of claim 44, wherein said sealing element comprises an elongate member having an interior cavity.

10 46. The apparatus of claim 39, wherein said frame assembly comprises a support plate with an upper surface against which the substrate may be placed and at least one raised surface around a periphery of the upper surface for engaging the substrate in order to limit lateral movement of the substrate.

47. The apparatus of claim 46, wherein said at least one raised surface is configured to engage outer edges of the substrate when the substrate is positioned in the frame assembly.

15 48. A method of positioning a substrate with at least one sample detection chamber into a sample detection instrument, comprising the steps of:

opening the sample detection instrument;
placing a support frame on the sample detection instrument;
inserting a substrate with at least one sample detection chamber in the support
frame;

5 placing a lens plate over the substrate and support frame, and aligning at least
one hole in the lens plate relative to the sample detection chamber of the substrate; and
closing the sample detection instrument.

49. The method of claim 48, wherein said step of placing a lens plate over the
substrate includes engaging a portion of the lens plate against a top surface of the at
least one sample detection chamber.

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